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GAME THEORY ANALYSIS OF SIMULATED COLLECTIVE NEGOTIATIONS.

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THE PURPOSE OF THIS STUDY IS TO DETERMINE IF THE FORMAT OF GAME THEORY IS APPLICABLE TO THE ANALYSIS OF COLLECTIVE NEGOTIATIONS IN EDUCATION AS EXHIBITED IN UCEA NEGOTIATIONS SIMULATION SITUATIONS. EIGHTY-FOUR SCHOOL ADMINISTRATORS, SCHOOL BOARD MEMBERS, AND TEACHERS PARTICIPATED IN THE EXPERIMENT AT TWO WORKSHOPS AND ONE SEMINAR ON THE UNIVERSITY OF IOWA CAMPUS. BOARD MEMBERS AND ADMINISTRATORS WERE RANDOMLY ASSIGNED TO BOARD TEAMS, AND TEACHERS WERE RANDOMLY ASSIGNED TO TEACHER TEAMS. AFTER BARGAINING THROUGH A SIMULATION OF COLLECTIVE NEGOTIATIONS, THE RESULTS OF THE SIMULATION AND THE OPTIMUM SOLUTIONS OF GAME THEORY WERE SCORED USING THE GUIDELINES FOR SCORING AS SUGGESTED BY THE UCEA NEGOTIATIONS GAME. A STRONG MAJORITY (87 PERCENT) OF THE PARTICIPANTS INDICATED IN A POST-SESSION QUESTIONNAIRE THAT THE EXERCISE WAS FROM MODERATELY TO HIGHLY SIMULATED. A MAJORITY (65 PERCENT) FELT THAT BOTH SIDES FARED EQUALLY WELL IN THE FINAL CONTRACT. A STRONG MAJORITY (88 PERCENT) WERE FROM MODERATELY TO COMPLETELY SATISFIED WITH THE CONTRACT RESULTS OF NEGOTIATION. RESULTS INDICATE THAT THE UCEA EXERCISE IN NEGOTIATIONS IS A WORTHWHILE INTERMEDIATE STEP TOWARD A SIMILAR STUDY OF GAME THEORY AND ACTUAL NEGOTIATIONS. THIS PAPER WAS PRESENTED AT THE ANNUAL MEETING OF THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION (CHICAGO, ILLINOIS, FEBRUARY 8-10, 1968). (HM)

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GAME THEORY ANALYSIS OF SIMULATED COLLECTIVE NEGOTIATIONS

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In a symposium on Feedback in Simulation Techniques at the 1967 AREA annual meeting Horvat gave a presentation, "Feedback in the Negotiations Game."[1] In this he described the Negotiations Game[2] that was developed by the University Council for Educational Administration under his guidance. Horvat pointed out that this game was not a game in the game theory sense but a simulation device. He also indicated it has some of properties of n-person, non-zero-sum, cooperative games such as conflict of interest, competitive and collaborative decision-making, and definite pay-off utilities for each of the players, the simulation could not be considered a game because the game moves are not well defined, all of the possible outcomes are not specified, and the game players are not aware of the preferences of the other players. Horvat doubted that simulations of real-world situations could ever be subjected to the rigors of game theory analysis.

The application of game theory to real-life conflict situations has intrigued people from many fields. In the area of labor management disputes, Allen[3] proposed the application of game theory to collective bargaining. He presented a solution to a hypothetical bargaining situation in the auto industry using

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[1]John J. Horvat, "Feedback in the Negotiations Game," (paper read at the American Educational Research Association annual meeting, New York City, New York, February 18, 1967).

[2]_____, Professional Negotiations in Education, A Bargaining Game (Prototype edition; Columbus, Ohio: The University Council for Educational Administration, 1966).

[3]Layman E. Allen, "Games Bargaining; A Proposed Application of the Theory of Games to Collective Bargaining," The Yale Law Journal, 65:660-693, April, 1956.

game theory. He based his model on Nash's two-person cooperative games[4] from game theory.

Allen used a hypothetical model but did not test it. Horvat developed a simulation bargaining situation but did not analyze it with game theory. The study at the Iowa Center for Research in School Administration, the University of Iowa, took the analysis of collective negotiations by game theory one step further toward the real life situation by applying game theory to a simulation of collective negotiations.

Purpose of the Study

The purpose of the study was to determine if the format of game theory is applicable to the analysis of collective negotiations in education as exhibited in simulation situations. The specific questions that were to be answered are the following:

1. Do participants in the UCEA negotiations simulation feel that these materials have relevance to collective negotiations?

2. Do the optimum solutions of negotiations issues included in the UCEA negotiations simulation as determined by game theory differ significantly from the solutions determined by teams of teachers and school board members taking the roles of negotiators?

3. Do the results of these comparisons provide an indication that game theory may be of value when applied to teacher-board collective negotiations?

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[4]John Nash, "Two-Person Cooperative Games," Econometrica, 21:128-40, January, 1953.

Procedure

The investigator, in consultation with several specialists in school administration and mathematics, determined that there was a strong potential in the use of game theory in the analysis of collective negotiations. When the UCEA Negotiations Game became available it was decided to change the study from an investigation of actual collective negotiations to an intermediate step of an experiment in the use of game theory in the analysis of a simulated collective negotiations situation. The UCEA Negotiations Game was modified for this study by adding five negotiations issues that represent board demands to the seven teacher demand issues in the short form of the game.

Invitations were extended to the superintendents of Iowa's fifty highest enrollment schools to bring school board members and teachers to sessions of simulated collective negotiations. Eighty-four school administrators, school board members, and teachers participated in the experiment at two workshops and one seminar on the campus of the University of Iowa. Board members and administrators were randomly assigned to board teams and teachers were randomly assigned to teachers teams. Teams of school board members and administrators and teams of teachers weighed the negotiations issues prior to the sessions. These weights were used to obtain the optimum solutions by Nash's two-person cooperative games for each negotiations group.

In a game the optimum solution is obtained by determining the greatest product of the pay-offs for the two players. The pay-off for a player is the net gain in a play of the game.

In this study an iterative approach was used to find the pair of pay-offs that were equal or almost equal to get the maximum product. After bargaining through a simulation of collective negotiations the results of the simulation and the optimum solutions of game theory were scored using the guidelines for scoring as suggested by the UCEA Negotiations Game. The differences of these scores for each issue in each group were tested using the Wilcoxon signed-rank test.[5]

Results

A strong majority of the participants (87.0 per cent) indicated in response to a post-session questionnaire that the exercise in collective negotiations was from moderately to highly simulated. The majority of the negotiators (65 per cent) felt that both sides fared equally well in the final contract. A strong majority (88 per cent) were from moderately to completely satisfied with the contract results of the negotiations.

At the .05 level of significance the null hypothesis of no significant difference in the game and simulation solutions was rejected for one group and retained for twenty groups. A post hoc examination of the data revealed two groups were significant at the .10 level and four groups at the .20 level.

Conclusions

The results from the post-session questionnaire indicated the UCEA exercise in negotiations has relevance to collective

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[5]Merle W. Tate, Richard C. Clelland, Nonparametric and Shortcut Statistics (Danville: Interstate, 1957), pp. 101-2

negotiations as defined by Lieberman and Moskow:

> Collective negotiations is regarded as a process whereby employees as a group and their employers make offers and counter-offers in good faith on the conditions of their employment relationship for the purpose of reaching a mutually acceptable agreement.[6]

This conclusion was necessary for this experiment to be a worthwhile intermediate step toward a similar study of game theory and actual negotiations.

The results of this experiment indicate that actual board members and teachers playing their respective negotiator roles in the exercise of the UCEA simulation of collective negotiations in education arrived at solutions that did not differ significantly from the optimum solutions determined by Nash's two-person cooperative games. This tenable conclusion does not give support to the doubts of Horvat that simulation of real-world situations can ever be subjected to the rigors of game theory analysis.

The results of this experiment further provide an indication that game theory may be of value when applied to real-world teacher-board collective negotiations. Some empirical testing in actual collective negotiations would seem to be the next logical step. If results similar to this experiment occur, then this approach or one very much like this could possibly be used by arbitrators in impasse situations in collective negotiations in education.

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[6]Myron Lieberman and Michael H. Moskow, Collective Negotiations for Teachers (Chicago: Rand McNally and Company, 1966), p. 1.

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APPENDIX A

Nash's Two-Person Cooperative Games

Axiom I: The players are said to be rational. The player when he has two alternatives chooses the one which yields the more preferred outcome.

Axiom II: There is an optimum solution in each game. This is set of strategies that result in largest product of pay-offs.

Axiom III: The optimum solution is in the negotiation set along with other possible solutions that result in positive pay-offs for both parties.

Axiom IV: The solution is not affected by a linear transformation of the utilities.

Axiom V: The solution does not depend on the order of the players; that is, player one could exchange positions with player two. The game is symmetrical.

Axiom VI: A restriction of the set of strategies available to a player cannot increase the value to him of the game.

Axiom VII: There is some way of restricting both players to single strategies without increasing the value to player one of the game.